NC STATE UNIVERSITY

scope

FALL/WINTER 2003 A LOOK INSIDE THE COLLEGE OF PHYSICAL AND MATHEMATICAL SCIENCES

A better way to manage disease?

These statisticians are working to solve an intriguing mystery about HIV patient treatment. What they learn may help doctors better manage other complex diseases.

College explores exciting interface of disciplines

It's been said that everything biological—at its root—is chemical, and that everything chemical at its root is governed by physics, and that physics at its root is mathematics.

While this may be a simplistic statement, it does express the close relationship of the physical and mathematical sciences to the biological sciences—a relationship offering tremendous opportunities for discovery.

Our College aims to achieve world-wide prominence as "the place to be" for study and research in selected areas that include, for example, nanoscale science, bioinformatics, and air and water quality. Our focus on these areas builds on our current capabilities and is shaped by our opportunities for partnerships and by the national agendas for science.

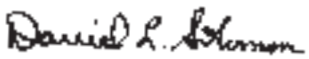
Many of these areas not only cross the traditional boundaries of our own disciplines in the physical, mathematical, and computational sciences but engage faculty and students at the intersection of our disciplines with the biological and biomedical sciences. It's at this interface that some of the most exciting science is going on, and where many of the most important discoveries will be made for the foreseeable future.

In the last issue of *Scope*, we described the work of two chemists who have had great success developing a nanoparticle delivery system that may someday be used to target specific cancer cells, enter them and deliver drugs, or even self-destruction instructions. In this issue, you'll read about a team of statisticians who are working to solve puzzling questions about HIV treatments.

Their work may be used to develop more effective treatment strategies for this and many other, complex diseases.

In fact, the work of these statisticians recently earned them a rare, prestigious NIH MERIT Award, which can provide research funding for up to 10 years, with a total value of more than $2 million.

In our College, we've made a strategic decision to build programs at the interface between the physical and mathematical sciences and the biological and biomedical sciences. Receiving the MERIT Award is a significant endorsement of our direction and program strength, as well as the stature of our faculty.



Daniel L. Solomon, Dean

PHOTO BY ANITA STALLINGS

Frank Hicks (Physics '93) chats with Dean Dan Solomon at an August alumni gathering in San Francisco. During the event, Dean Solomon updated alumni on the College's activities, including its interdisciplinary research efforts.

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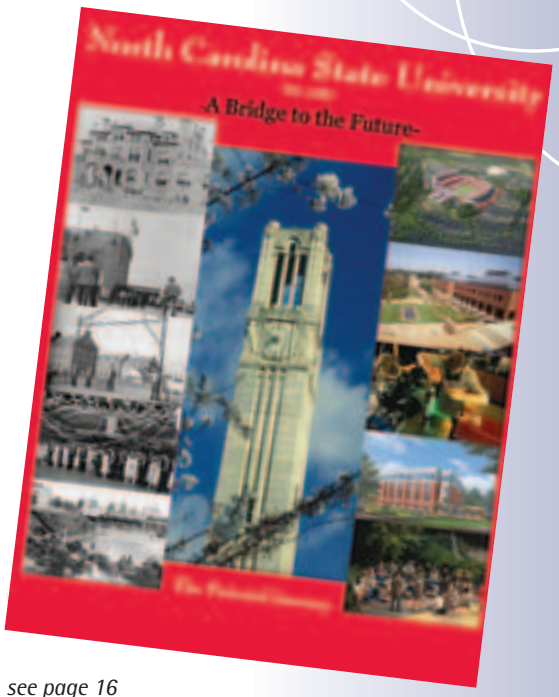
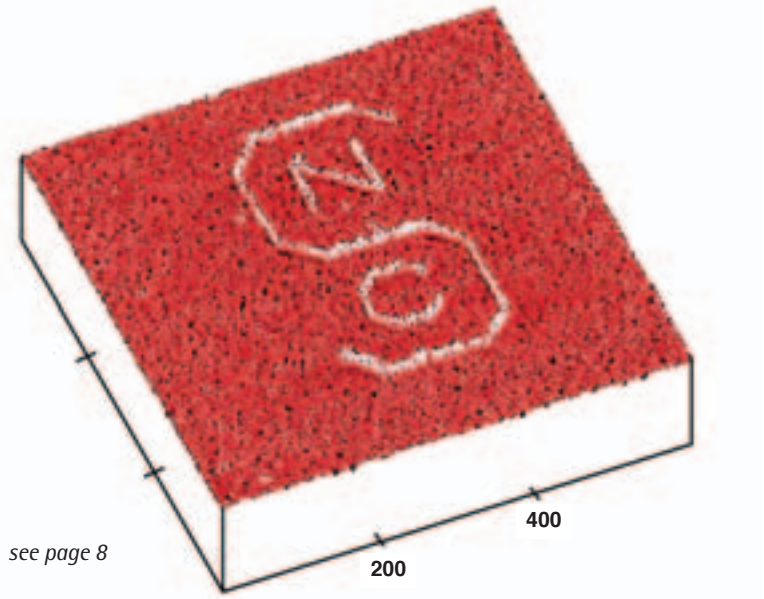
scope

A LOOK INSIDE THE COLLEGE OF PHYSICAL AND MATHEMATICAL SCIENCES FALL/WINTER 2003

In this issue...



see page 16



see page 8

On the cover: Statistics Professors Marie Davidian and Anastasios "Butch" Tsiatis and Associate Professor Marc Genton (photo by Roger Winstead)

Christine Hemrick honored as 2003 Distinguished Alumna

The College of Physical and Mathematical Sciences recently honored Christine Hemrick as its 2003 Distinguished Alumna.

Hemrick received a BS in Mathematics in 1974 and graduated summa cum laude. She is vice president for technology policy and consulting engineering for Cisco Systems, Inc.

Before joining Cisco, she held technology positions at Bellcore, GTE Telenet, and Digital Equipment Corporation.

Hemrick also served as a Senior Staff member at the National Telecommunications & Information Administration (NTIA) of the U.S. Department of Commerce.

Hemrick's expertise is in great demand. She was appointed by U.S. President Bill Clinton to co-chair the Presidential Advisory Committee on Expanding Training Opportunities, and she served for four years as a member of the Technological Advisory Council to the U.S. Federal Communications Commission.

She also is an avid conservationist and serves as a trustee of the African Wildlife Foundation and the Cheetah Conservation Fund, USA.

Recognized as a leading expert in information and communications technologies, Hemrick is highly sought by organizations such as the United Nations and World Bank as an international conference presenter.

She often speaks on the challenges of helping least-developed nations build information technology resources, and the importance of recruiting more women into science and technology careers.

"These are important discussions, and ones that will surely affect the technology, business and education policies of many nations for years to come, potentially impacting the lives of billions of people," said Dean Daniel L. Solomon. "We are very proud that one of our NC State alumni has such an influential role in improving the human condition."

During her visit to campus for the Alumni Association Distinguished Alumni Awards Luncheon and the College awards dinner, Hemrick met with a group of participants in the Women in Science and Engineering Program.

She shared with the students some personal perspectives on career direction, communications skills and educational opportunity. The group also discussed at length Hemrick's interests in the environment, and the preservation of natural habitat by preserving indigenous cultures.

"Whether she's speaking to a group of students gathered in a dormitory activity room, or addressing a gathering of world leaders at a United Nations conference, Christine uses her technical knowledge, her leadership skills, and her social conscience to make positive differences—both big and small," Solomon said. "We can ask no greater achievement of our graduates than this."

PHOTO BY SALLY RAMEY

Dean Dan Solomon presents 2003 Distinguished Alumna Christine Hemrick with a mantle clock.

Student/ Alumni Notables

Robert Reeves Anderson, (Chemistry, Political Science, '02) received a Rotary International Ambassador Scholarship of $25,000 to pursue study in another country for one year.

Justin Brockman (Physics, Applied Mathematics, '03) received a prestigious Goldwater Scholarship for 2003–04.

Jennifer Carrozzino (Chemistry PhD graduate student)—best paper, "Young Scientists Session," 14th Annual Frederick Conference on Capillary Electrophoresis, an international conference

Nathan George (Physics, Mathematics, '02) received a $32,000 Gates Cambridge Trust Scholarship for post-graduate study at Cambridge University.

Alumni gather in far-away places

Taking advantage of Dean Daniel Solomon's attendance at a national statistical conference, a group of alumni in the Greater San Francisco Bay area gathered at the home of Lawrence Ives (Physics, '73, '76, '84) to hear what's going on with PAMS.

The social was hosted by Ives and Meredith Williams (Physics, '94), both members of the PAMS Foundation board of directors. The social was attended by 31 alumni, some of whom were surprised to find familiar faces in the group.

About 175 of the 1,200 NC State alumni in the Bay area are PAMS graduates.

"We were delighted to have this opportunity to meet with alumni who are so far from North Carolina," said Solomon. "The relationship between a university and its alumni is a life-long one, and distance does create an obstacle to this connection."

Solomon took the opportunity to update the group about the direction of the College, its fundraising priorities, and its vision for the future.

The College is also working with its departments to inform and involve alumni. The Statistics Department has traditionally hosted an alumni social at the annual Joint Statistical Meetings. This year, the event was held in San Francisco and was attended by about 100 alumni.

At two recent meetings of the American Chemical Society, chemistry graduates were invited to gather at informal socials. Several alumni met with faculty and staff representatives in New Orleans and New York.

If you would like to be involved in future alumni events, please contact pamsalumni@lists.ncsu.edu.

TWO PHOTOS AT RIGHT BY ANITA STALLINGS

Meredith Williams and fellow NC State alumnus Dave Balance at the San Francisco event.

James Robenolt (Meteorology '85) and David Weintraub (MS MEAS '86) catch up at the San Francisco event.

TWO PHOTOS AT RIGHT BY CYNTHIA WERTZ

Dicky Morrison, Hank Ramsey (Chemistry '76) and PAMS Assistant Dean for Administration Bob Morrison enjoyed some social time at the Chemistry Department's reception at the New York American Chemical Society meeting.

Chemistry alumae Dr. Anne Glenn ('84) and Dr. Christine Brennan ('87) at the New York social.

New Web site provides instant access to weather observations

Just in time for Hurricane Isabel's arrival, the State Climate Office (SCO) unveiled a new Web site that provides the public with instant access to weather data collected from nearly 200 stations around the Southeast.

The N.C. Climate Retrieval and Observations Network of the Southeast (NC CRONOS) provides comprehensive, real-time access to weather observations from 90 automated stations across the state, including offshore buoys, and 110 additional stations in surrounding states.

The Web site—www.nc-climate.ncsu.edu/cronos—incorporates climate information gathered by the SCO, the National Weather Service, the N.C. Department of Transportation, the U.S. Department of Agriculture and the National Data Buoy Center.

According to Dr. Sethu Raman, state climatologist and director of the SCO, "This Web site and its supporting database give citizens and businesses in North Carolina a source for real-time local weather and climate information, a resource not previously available."

Accurate and reliable weather information is essential for farmers, electric utilities, transportation firms, airlines, the tourist industry, military and crisis planners, public health officials—the entire spectrum of citizens, governments and businesses.

"Weather observations must be of the highest quality to be useful for decision-making purposes," said Raman. "There are many weather sensors out there, but most are not installed and maintained to international standards. We will provide only the highest quality weather observations."

Colorful maps and numerous features were designed to make navigating the Web site easy.

"Our team of staff and students, led by Associate State Climatologist Ryan Boyles, spent a lot of time considering the needs of likely users, from parents planning a weekend trip to construction firms scheduling work," said Raman. "Our maps and tables let you glance at current conditions across the state or, for those who need greater detail, let you drill down to multiple layers of information."

Buoys Away!

NC State faculty and technicians spent part of the summer off the coast of the Carolinas, dropping buoys into the water for a new coastal observation system.

The Carolinas Coastal Ocean Observing and Prediction System (Caro-COOPS) initiative is based on an instrumented array of estuary, coastal and offshore moorings. This system enables scientists to monitor and model estuarine and coastal ocean conditions, as well as develop predictive tools.

Data from Caro-COOPS will be used to develop an advanced, integrated storm surge model, based on real-time monitoring of hydrologic, meteorological and oceanographic conditions.

Other areas of study include water quality and transport of pollutants, sediment transport and shoreline stability, and the state of the fisheries. Caro-COOPS provides a sophisticated information management infrastructure designed to process and deliver information to a variety of public users, as well as to model applications. Caro-COOPS is a partnership among NC State, the University of South Carolina and the University of North Carolina at Wilmington. It is funded by the National Oceanic and Atmospheric Administration.

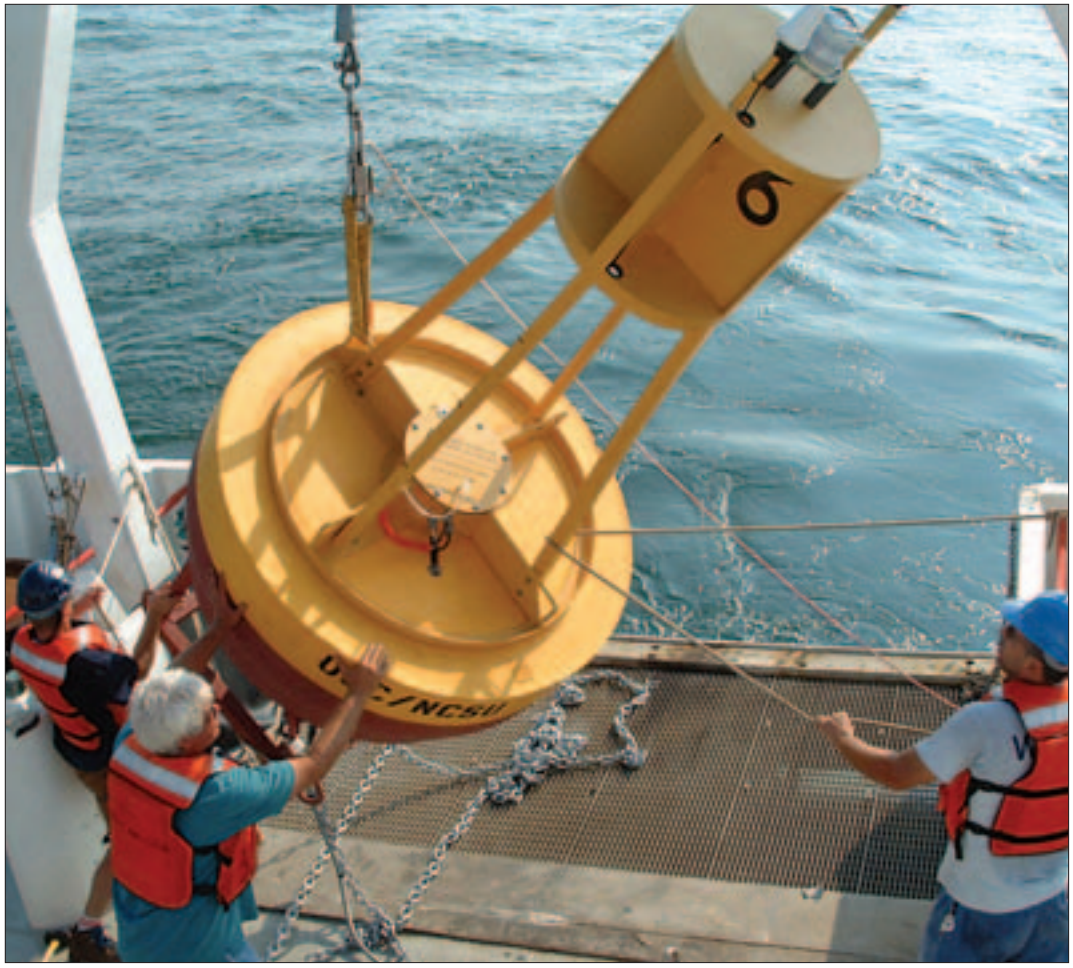


PHOTO BY BILLY SWEET

Alumnus discovers West Nile in alligators

Mitch Troutman, who received degrees in chemistry, zoology and veterinary medicine from NC State during the 1990s, played a key role in the first diagnosis of West Nile Virus in reptiles.

In October 2002, three small alligators from Clabrook Farm, an alligator farm near Orlando, were sent to the University of Florida's Veterinary Medical Teaching Hospital in Gainesville, where Troutman works as a pathologist.

The alligators arrived with severe clinical signs veterinarians described as "classic neurological symptoms"—circling, head-tilting and wobbling.

When the alligators, from 12–15 inches long, were necropsied, Troutman and his colleagues became intrigued—they had never seen encephalitis in alligators at this level.

"There was inflammation in the brain, spinal cord, heart, liver and spleen," said Troutman, who performed the necropsies. "It looked very similar to what a bird infected with the West Nile virus might experience."

Tests performed by Troutman's colleagues on the alligators' brain tissue indicated the presence of West Nile virus antigens in neurons. Tissue samples later tested by the Florida Department of Health and the Centers for Disease Control confirmed the presence of West Nile Virus in the alligators.

"We found that, like birds, these alligators serve as amplifying hosts, meaning that if bitten by a mosquito while infected, they could pass the virus on via the mosquito," said Troutman. "So we believe that alligators may serve as a vertebrate reservoir host for West Nile Virus, similar to the role birds serve as a reservoir host."

PHOTO COURTESY OF UNIVERSITY OF FLORIDA

Mitch Troutman

NC State to develop flood warning system

Residents of the United States are familiar with the ratings of tornados and hurricanes. Most people are aware that F-5 tornados are much more powerful than F-1s, and that Category 5 hurricanes are much stronger than Category 1 storms.

But what about floods?

How can forecasters help residents understand and prepare for flooding to an extent proportional to the threat?

Lian Xie and Len Pietrafesa, both professors in the Department of Marine, Earth & Atmospheric Sciences, are working with the National Weather Service in Raleigh on a research project into inland flooding associated with hurricanes and tropical storms. Another research partner is Dave Dickey, a professor in the Department of Statistics, who will be conducting a statistical data analysis.

In addition to gaining a better understanding of the impact of land and shore pre-storm conditions that contribute to storm-related flooding, they hope to develop a warning scale similar to the Saffir-Simpson hurricane and Fujita tornado scales.

"A warning scale would help residents better understand and prepare for flood conditions in their local area," Xie said.

This research is funded by federal research grants made possible by the Inland Flood Forecasting and Warning System Act, introduced by N.C. Congressman Bob Etheridge in the aftermath of Hurricane Floyd's devastating floods. He worked closely with NC State researchers and other specialists in crafting the bill and gathering the necessary information to get it passed.

NC State is not the only university to receive a portion of this bill's research funding, which is awarded through competitive grants.

"While this bill was born out of a North Carolina flooding disaster, it made available about $5 million in research funding for anyone exploring related aspects of flooding," Pietrafesa said. "Advances in the understanding of flooding will impact emergency management practices across the nation, potentially saving countless lives."

Chemists provide first insight into simple polymer behavior

KISS... "Keep it simple, Sir." We've all heard some version of this timeless piece of advice. However, in some cases this is hard to do. Such is the case for polymer mixtures, or blends.

Polymer blends are usually mixtures of chemically complex polymers. Blends of complex polymer materials are used in many everyday items, but they are expensive and are often not environmentally friendly.

"Simple hydrocarbon polymers are economically and environmentally attractive alternatives to many expensive, synthetically, and environmentally challenging polymer products currently in use," said Assistant Professor Jeffery L. White.

Blends of simpler polymers, such as saturated polyolefins, could be better choices for use in the automobile, appliance, and food packaging industries, among others, since they are chemically resistant, resist attack by oxygen and ozone, and are easier to recycle than other more complicated polymers.

So why aren't we making new materials by blending these simple polymers?

When chemists try to make new materials by blending very simple polymers, such as those containing only carbons and hydrogens, it usually doesn't work. The reasons why simple polymers are harder to manipulate than complex ones are unknown, presenting a challenging scientific and economic problem.

"The simpler polymers more often than not violate the old adage that 'like dissolves like', in that they prefer to separate from one another much like oil and water, instead of mix with each other as expected," said White.

PHOTO BY SALLY RAMEY

Dr. Jeff White holds two bowls of pasta that illustrate of the challenges of mixing simple polymers. In the bowl on the left, the pasta is thoroughly mixed, representing the successful creation of a new material by blending simple polymers. However, the pasta in the other bowl represents what usually happens when mixing polymers—they "clump." White's research seeks to understand, and then overcome, this tendency.

Ultimately, to make a new material with the desired performance properties, the polymers' molecular "chains" have to intertwine with one another.

To understand why these simple polymers behave in complicated ways, White's research group has used a technique called solid-state nuclear magnetic resonance, (NMR), a relative of the medical industry's magnetic resonance imaging (MRI). Their work shows that a key, missing piece of the puzzle is an experimental understanding of how energy is distributed in these polymer mixtures.

In other words, they have provided the first experimental proof that the way these long-chain macromolecules can move in space, or what is technically called "configurational entropy," is an important factor controlling how they mix.

Because of its fundamental scientific and economic importance, the National Science Foundation, the National Research Council, and a DuPont Science and Engineering Award have supported this work.

PLU Seminar features K.C. Nicolaou

Renowned organic chemistry professor KC Nicolaou will present the Phi Lambda Upsilon (PLU) Distinguished Lecturer Seminar on "Perspectives in Total Synthesis" Feb. 24, 2004 at 3 p.m. in the Witherspoon Center Cinema. He will sign copies of his new book, *Classics in Total Synthesis II.* A description of his book can be found at BarnesandNoble.com.

Nicolaou holds a joint appointment with UCSD and Scripps Research Institute. For more information, visit www.ncsu.edu/chemistry/chem.html.

PLU is the chemistry student honor society.

Flash flood strikes campus

What? How could that happen, you say?

Try dropping three inches of rain onto campus in 30 minutes.

On July 30, a thunderstorm's freakish downpour overcame drainage systems, leaving Hillsborough Street under two feet of water and cars floating on Avent Ferry Road.

A small river flowed down from the brickyard, joined with water that had overflowed the courtyard between Cox and Harrelson, and rushed around Cox to the parking lot beside Bureau of Mines.

Faculty, staff and students gathered in the Cox hallway overlooking the parking lot and watched in amazement. A university van and a car belonging to Rebecca Savage of the Physics Department were in the lot. People discussed how to move the car out of danger.

In the time it took for someone to say, "It looks like you could get in from the back door without getting your feet wet," the water rose up to the top of the wheel wells.

As water rose in the parking lot, it entered the Bureau of Mines' basement, buckling an interior wall and spraying into Dr. Hans Hallen's physics lab from around a closed door. Hallen and his students made a hasty retreat up the back stairs, as the lab filled with three feet of water.

Meanwhile, the parking lot was under about five feet of water, almost submerging the van and car. At one point, the Free Expression Tunnel was almost completely filled with water. And an ironic electrical short periodically caused the flooded car's wipers to dutifully sweep the rain from its windshield.

Then, as quickly as it began, the rain stopped and the water drained away. Almost 50 campus buildings suffered some sort of damage, but the Bureau of Mines was hit worst.

"We're very fortunate that no one was hurt," said Chris Gould, head of the Physics Department. "We also were fortunate that we didn't suffer more equipment damage. We first cleared out anything that could be damaged by the humidity and spent the next several days clearing everything else out and cleaning it."

"It felt strange to hose down a $50,000 piece of equipment that's not meant to get wet at all," said Hallen, who kept a sense of humor throughout the ordeal.

By the time fall classes started, things were back to normal. Hallen's laboratory was relocated to the building's first floor. The basement underwent complete renovation.

And Savage has a new car.

PHOTOS THIS PAGE BY SALLY RAMEY

At its highest, the flood water was within three inches of the Free Expression Tunnel's ceiling.

Flood water filled the Bureau of Mines parking lot when a large drain was clogged by mulch washed into it by the heavy downpour. The water rose another foot after this photo was taken.

Molecule by molecule, interdisciplin

When tomorrow's amazing new computers and other electronic devices emerge, they will have been conceived in university laboratories like that of Dr. Chris Gorman, professor of chemistry at NC State.

Gorman and a multidisciplinary team are working to build, molecule by molecule, a nanoscale transistor.

That's an electronic switch so small it can be seen only with a high-tech device called a scanning tunneling microscope. And if you go to the library to find the "how-to" book, said Gorman, "most of the pages will be blank, because nobody yet knows how to do it."

And that, for the chemists, engineers and students engaged in the project, is what makes their painstaking, pioneering research so satisfying. If they can design and construct a nanoscale transistor, they will have filled in many blank pages in the how-to book. The field is so new, the research avenues so unexplored, that each experiment and each variation helps write that book.

Their work is guided by the "bottom-up" approach to building something, said Gorman.

"Most things are built using 'top-down' methods, such as when you take a chunk of metal, stone or wood and carve off the material you don't want, until you have an I-beam or a two-by-four," he said. "In contrast, we're interested in assembling molecules, and building a functioning transistor—with as few molecules as possible."

A persuasive advocate of multidisciplinary research, Gorman leads a team that includes Dr. Daniel L. Feldheim, associate professor of chemistry, and Dr. Gregory N. Parsons, associate professor of chemical engineering. They combine this bottom-up approach with Parsons' top-down engineering in the creation of the nanoscale transistor. Parsons will construct a molecular platform with a tiny indentation into which Gorman, Feldheim and their students hope to fit a molecular "plug." The resulting structure should function as an electronic switch—the definition of a transistor.

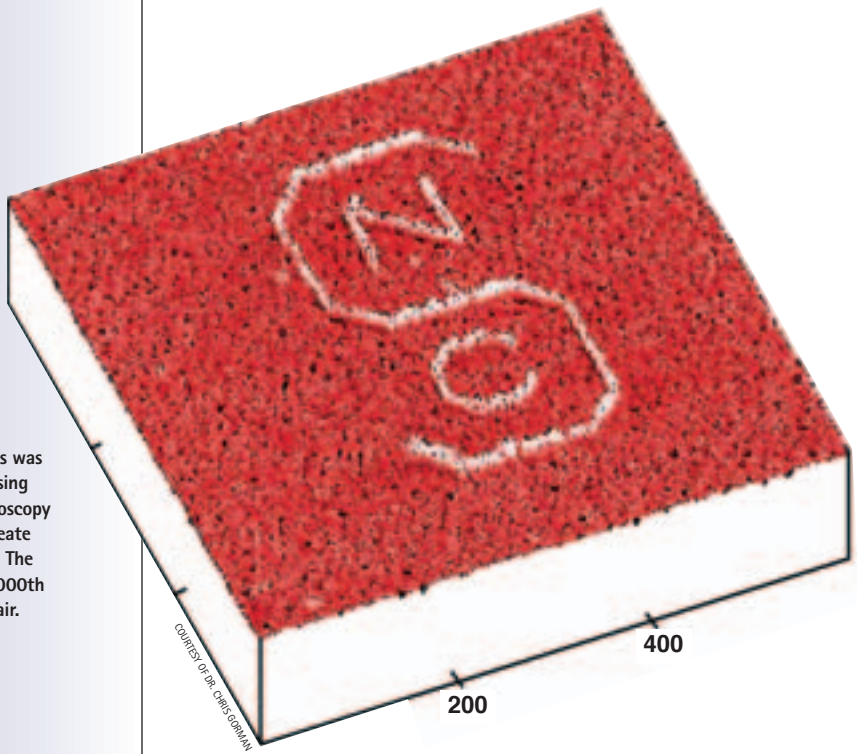
> *"Imagine the contents of a library in a postage-stamp-sized chip, and you can begin to ponder some exciting possibilities, and the next phase of electronics development in the US."*
>
> *— Dr. Chris Gorman*

"Our research will tackle two critical issues in the development of future materials for advanced molecule-based information processing," says Gorman. "One—how to assemble and attach single molecules to electronic contacts and, two—how to create electronic gain—the fundamental operating principle of a transistor—at the molecular level."

The benefits of the team's success could be far ranging.

"Better techniques for information processing will keep our economy growing stronger by enabling smaller, faster and lighter electronics," Gorman said. "Imagine the contents of a library in a postage-stamp-sized chip, and you can begin to ponder some exciting possibilities, and the next phase of electronics development in the United States."

While the private sector and corporate research and development will ultimately develop such technologies, Gorman said, the fundamental research—with its exploration of byways and promising side streets, false starts as well as serendipitous



This pattern of molecules was created and visualized using scanning tunneling microscopy like that used to help create the nanoscale transistor. The letters are less than 1/1000th the width of a human hair.

ıary team designs a new transistor

PHOTO BY SALLY RAMEY

Members of the Gorman Group include (seated) Matthew Lewis, Tiffani Bailey, Aneta Dembowa, Brandon Walker, Tyson Chasse, (first row standing) Angela Allen, Holly Robuck, Ronald (Drew) Wassel, Young-Rae Hong, Szymon Dembowy, Ryan Fuierer, (second row standing) Dr. Christopher Gorman, James (Peyton) Hassinger, Namjin Kim, James Williams, Randy Petrie, Jennifer Ayres, Christopher Cameron and Christopher Monceaux. Not shown are William Capshaw, Jonah Jurss and staff member Megan Ives.

discoveries—must take place in universities, with federal and state help. Gorman's research, for example, is funded by the National Science Foundation through its Nanoscale Interdisciplinary Research Teams (NIRT) program.

Another must, according to Gorman, "is fundamentally changing how the next generation of technically savvy students is educated. In our research, we want our students to pursue studies that involve traditional science, engineering and technology-development aspects and state-of-the-art research approaches. We also want to expand the opportunities for women and minorities to participate in this new, interdisciplinary paradigm."

As evidence that this new paradigm is already taking shape, Gorman's undergraduate and graduate students, "the Gorman Group," are fully engaged in his quest for the nanoscale transistor. From the newest students to veteran grad students, the group collaborates in exploring the nanoscale realms for promising applications.

"With the increasingly fast pace of technological change," says Gorman, "it's possible that many of the rules that we teach students in college can be obsolete by the time they graduate. That's why we must focus on how to think, how to solve problems, how to explore the unexpected avenues and surprising new paths—and, in some ways, to disregard traditional disciplinary boundaries."

Disregarding traditional boundaries may be a necessary practice for all successful scientists, especially the pioneers, such as Gorman, working at the very edge of the possible. When the next generation of technology transforms our lives, it will have been conceived and perfected in university labs, built grant by grant, student by student, molecule by molecule.

Eli Lilly makes generous gift to Chemistry Department

Thanks to the generous support of Eli Lilly, the Department of Chemistry now has a new graduate fellowship, undergraduate scholarship funding and seminar.

The graduate fellowship will provide support for a third- or fourth-year PhD student in chemistry, with preference for a student in organic, synthetic, medicinal, or bio-organic chemistry. This fellowship also will provide an allowance for travel to professional meetings.

The undergraduate scholarship funding will help support undergraduate chemistry students with preference given to those with interest in organic, synthetic, medicinal or bio-organic chemistry.

In recognition of the unique importance of seminars to graduate students' educational experience, Eli Lilly also provided funding for an organic chemistry seminar program, which will be inaugurated in the fall of 2004.

Physicists make macro step for microelectronics

The ability to make atomic-level changes in the functional components of semiconductor switches, demonstrated by a team of NC State, Oak Ridge National Laboratory and University of Tennessee physicists, could lead to huge changes in the semiconductor industry. The results were reported in the June 13, 2003 issue of *Science*.

Semiconductor devices, the building blocks of computing chips that control everything from coffee makers to Mars landings, depend on microscopic solid-state transistors, tiny electronic on-off switches made of layers of metals, oxides and silicon.

These switches stop and start the flow of electrons, and work themselves because of the microscopic interface between the oxide layer and the silicon layer, in the realm of individual atoms, where minute positive and negative charges determine semiconductor success or failure.

Until now, researchers—and the multibillion-dollar semiconductor industries they support—had to accept the limitations that each crucial interface contains.

But researchers have successfully learned to "tune" the atomic-level zone between substances, in a development that they call "a unifying concept for understanding and designing" this aspect of semiconductor physics.

> *"...the team's work will change common beliefs in the field of semiconductor physics, and could open the way for smaller, faster and smarter computers."*
>
> *— Dr. Marco Buongiorno-Nardelli*

The atomic tuning, described in the paper "The Interface Phase and the Schottky Barrier for a Crystalline Dielectric on Silicon," takes place in what Dr. Marco Buongiorno-Nardelli, assistant professor of physics at NC State and one of the authors of the paper, has named the "Coulomb buffer." Here, at the boundary between silicon and oxide, there is an interface phase that is neither silicon nor oxide but its own hybrid structure.

Buongiorno-Nardelli, studying this interface phase at the atomic level using high-performance computer simulations, found that the fundamental basis for this tuning was in increasing or decreasing the electronic "dipole charge"—the microscopic arrangement of positive and negative charges at the interface.

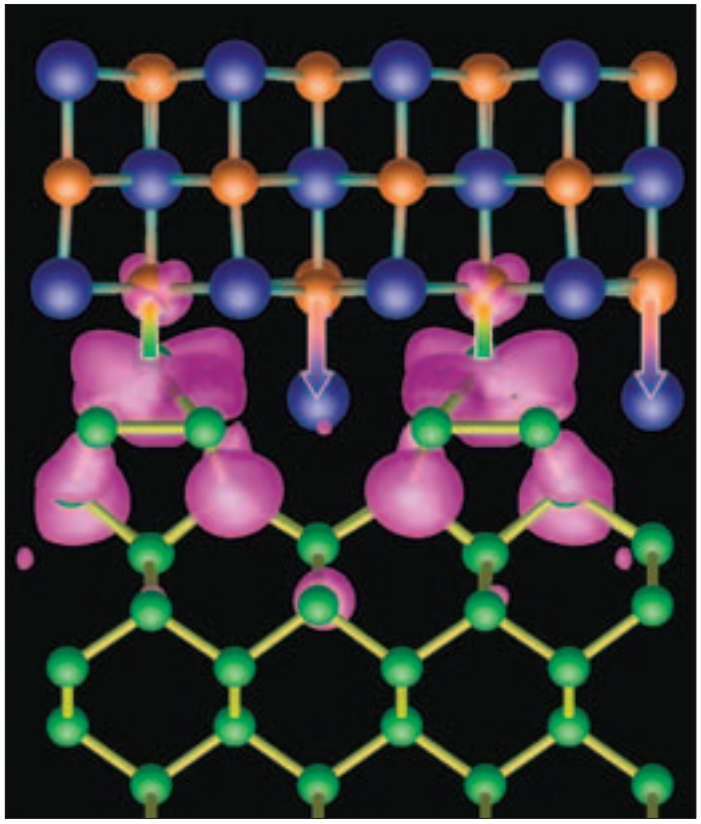
The teams' sophisticated experiments demonstrated that the Schottky barrier—the boundary at the edge of a substance where electrons are confined, long considered an inflexible limitation—can in fact be manipulated, and that "barrier height" is, in Buongiorno-Nardelli's words, "no longer a problem, but an opportunity."

According to the NC State physicist, who holds a joint appointment at Oak Ridge National Laboratory, the team's work will "change common beliefs" in the field of semiconductor physics, and could open the way for smaller, faster and smarter computers.

And manufacturers, able to tune the atomic dipoles in the Coulomb buffer for specific electronic characteristics, may find that this discovery deep in the micro-regions enables macro-steps forward in efficiency and productivity.

The U.S. Department of Energy's Office of Science funded the team's research. The Oak Ridge National Laboratory is a Department of Energy facility.

COURTESY OF DR. MARCO BUONGIORNO-NARDELLI



This image illustrates the concept of "Coulomb buffer," the region between oxide (above) and silicon (below) in nanoswitches, that can be "tuned" through atomic-level manipulation for desirable semiconductor characteristics, an advance that benefits both researchers and manufacturers.

Sayers receives international honor

Physics professor Dale E. Sayers has received the IXS Outstanding Achievement Award. Presented only every three years, it is the highest honor presented by the International XAFS Society, the professional organization of scientists in fields relating to X-ray absorption fine structure (XAFS).

Sayers is considered a key pioneer of XAFS technology, and the award was presented as a career achievement honor.

Sayers helped develop XAFS technology, which became a major experimental tool about 20 years ago. It's now used around the world. The process enables scientists to study the atomic-level structure of complicated materials.

"This award means a lot to me because this is a community in which I have been involved for a very long time," Sayers said. "It's very gratifying to be recognized by your peers."

XAFS is useful in many applications. For example, it can help scientists better understand catalysts in certain reactions, enabling them to find more efficient ways to produce various materials, or to improve quality. Examples of such research at NC State range from gasoline production to fabrication of materials for better electrical contacts in new generations of semiconductors.

Sayers currently serves as chair of the PAMS faculty.

PHOTO BY SALLY RAMEY

Dr. Dale Sayers

Alumni share experiences with freshmen

"People who succeed are persistent."

"Make your own rules."

"Communications skills are vital. I should have paid more attention in English class."

These are among the many thoughts alumni recently shared with a class of freshmen in PAMS 100.

The class introduces PAMS majors to the college and provides a resource for easing the transition from high school to college. During one week this fall, five alumni guests were invited to talk with the students about their education, careers, the flexibility of a PAMS education, and how to achieve success.

"We are finding ways to involve alumni with students, and this week was an opportunity to expose students to the multitude of career directions that are open to them," said Dean Dan Solomon. "We are so appreciative of the alumni who took the time to meet with our freshmen."

One of the alumni was Suzanne Gordon, who graduated in 1973 with bachelor degrees in mathematics and computer science, and earned her master's in statistics in 1980. She is chief information officer and vice president of the information systems division at SAS Institute. She currently serves as a member of the university's board of trustees.

"Suzanne spoke to the students as a former student, as a top executive with one of the leading companies in her field, and as a mother," Solomon said. "The students were very engaged by her multiple perspectives and anecdotes. She spoke about flexibility, the importance of communication skills, being willing to fail and learn from the experience, forcing yourself out of your comfort zone—all concepts that students can put into practical use, no matter their major."

Other alumni speakers included Boyd Dimmock (MS Mathematics, '73), a senior software engineer at IBM; Jan Wooten (BS Chemistry, '73), a research scientist with Philip Morris Research Center; John Matthews (PhD Mathematics, 2000), a research associate with the Duke University Department of Mathematics; and Graham Gash (BS Chemistry, '69), a lab manager with the UNC Department of Computer Science.

PHOTO BY SALLY RAMEY

PAMS 100 students listen as Boyd Dimmock discusses insights gained from her work experiences.

Faculty/Staff Notables

Alton Banks (Chemistry)—appointed Director of the NC State Faculty Center for Teaching and Learning

Ryan Boyles (State Climate Office) and **Sally Ramey** (Dean's Office)—received CASE District III Award of Excellence for NC State 2002 Drought Conference

Naihuan Jing (Mathematics)—awarded Fulbright Scholarship and Alexander von Humboldt Research Fellowship

Tom Malone (Marine, Earth & Atmospheric Sciences)—inducted into South Dakota Hall of Fame

Len Pietrafesa (Marine, Earth & Atmospheric Sciences)—named 2003 Science Advocate of the Year, University Corporation for Atmospheric Research

Anastasios "Butch" Tsiatis (Statistics)—received Alumni Association Outstanding Research Award

NC State hosts StatFest 2003

Statisticians from colleges, universities, government agencies and businesses across the nation explained the benefits and advantages of careers in statistics for minority students at StatFest 2003, held recently at NC State.

Sponsored by the Committee on Minorities in Statistics of the American Statistical Association and other academic and business groups, the event was held for the first time at an institution other than a historically black college or university.

The one-day conference allowed Hispanic, African-American and Native American students to meet and discuss career opportunities with business, government and industry leaders as well as directors of graduate programs at participating universities. A record 145 participants registered.

"We are delighted to have been selected to host StatFest this year," said Dr. Sastry Pantula, Statistics Department head. "NC State has a strong commitment to encouraging minority students to pursue careers in science and technology. StatFest is an effective program and we hope the student participants now understand the tremendous opportunities waiting for them in this discipline."

Representatives from NC State, NC A&T, Shaw University, Hampton University, Knoxville College, Tennessee State University, Spelman College, Fayetteville State University, Claflin University, Livingstone College, Voorhees College, Florida A&M University, St. Augustine's College and Albany State University took part in the program.

The StatFest keynote speaker was Dr. Carolyn B. Morgan, professor and chair of the mathematics department at Hampton University. Workshops covered such topics as statistics in industry, academia and government, and graduate studies in statistical sciences. Dean Dan Solomon, also a statistician, welcomed the participants. Vice Provost Jose Picart also offered greetings.

PHOTO BY SASTRY PANTULA

The NC State SAA-PAMS team won the StatFest quiz bowl. Shown are Evelyn Frazier (Meteorology), Desmond Jennings (Meteorology), Victoria Moultrie (Mathematics), quiz bowl moderator Jeffrey Thomas (Statistics '02) and quiz bowl co-coordinator Dr. Kim Weems.

Dr. Willard Bennett honored by high school

Dr. Willard Bennett, professor of physics at NC State from 1961 to 1976, was recently inducted into the Norwalk High School Hall of Fame.

The Ohio school has for several years honored graduates who achieved distinction in academics, athletics and citizenship.

Local folklore is that Bennett "correctly identified the contents of a meteorite" while still in high school. He earned his diploma in 1921.

Bennett's research spanned several areas, including nuclear fusion, physical chemistry, astrophysics, geophysics and surface physics. He held 67 U.S. and foreign patents, the most well-known of which was for the Bennett radio frequency mass spectrometer.

Bennett died in 1987 at the age of 84. He was inducted posthumously into the National Inventors Hall of Fame in 1991.

COURTESY OF DEPARTMENT OF PHYSICS

Dr. Willard Bennett

Statisticians work to solve HIV mysteries

Despite great progress in the past decade, HIV disease is still one of the most challenging health care problems facing the human race today. This is one clever virus, one that mutates and adapts to new therapeutic assaults at a rate that keeps it just ahead of evolving treatment technologies.

In most medical settings, conventional wisdom says that patients should always take their drugs. However, this hasn't been the case with HIV.

Although the powerful therapies currently in use are capable of causing the amount of virus in the body to fall to levels undetectable by standard tests, they require patients to take upwards of thirty pills per day, and they are expensive. Many HIV patients simply can't continue and stop their treatments for a while. Then they go back on. Then they might stop again, and so on.

HIV researchers have observed that stopping can cause virus levels to skyrocket. But surprisingly, in many patients, virus levels stay low even in periods when they are off treatment. In still others, virus levels stay low even if they decide to discontinue their drugs indefinitely.

Why does stopping and starting treatment keep the virus at bay? Could going on and off treatment be an effective way to manage HIV disease?

The MERIT award will allow the statisticians to develop sophisticated statistical designs for especially complicated clinical trials.

These are some of the questions facing a team of NC State statisticians. Statisticians play a central role in medical research as the experts who develop study designs and methods of analysis to meet new and difficult challenges like these.

Dr. Anastasios "Butch" Tsiatis is the lead investigator of the team, which also includes Dr. Marie Davidian and Dr. Marc Genton. Their work shows such great promise that Dr. Tsiatis was recently awarded a five-year National Institutes of Health (NIH) award of $225,000 per year, or $1.125 million in total. The award is renewable for an additional five years, for a potential total of $2.25 million.

The Method to Extend Research in Time (MERIT) Award by the NIH's National Institute of Allergy and Infectious Diseases is given to outstanding investigators and is based on superior competence and productivity, according to the NIH.

Only four percent of NIH's research funding is provided through MERIT Awards. This program is meant to free researchers of the constant worry of obtaining funding, allowing them to instead focus completely on the research itself for up to 10 years. The award acknowledges the value of the statisticians' methodology in designing and analyzing complex clinical trials that could help answer some of these questions.

This research is not focused on developing new therapies. "Medical treatment is the job of physicians and clinical scientists," said Tsiatis. "Our research instead is focused on a framework, based in statistical theory, that allows any set of therapies to be compared and evaluated properly."

The MERIT award will allow the statisticians to develop sophisticated statistical designs for especially complicated clinical trials. Their challenge is to design such trials for treatments with many variables, unlike clinical trials with "simple" structures.

"With the advent of highly active antiretroviral therapy (HAART), which involves giving HIV-infected patients 'cocktails' of potent anti-HIV agents, great strides have been made in reducing mortality," Tsiatis said. "But long-term use of these cocktails is expensive, burdensome, and may lead to adverse reactions. So, HIV scientists are looking for new ways to use these drugs to achieve fewer complications and better prognosis."

One promising approach, he said, is "structured treatment interruption," where patients cycle on and off treatment—on purpose.

The idea is to cycle patients on and off treatment according to how well their immune system is fighting the HIV virus. But patients' widely varying responses to such cycling—and the possible variations in how to do the cycling—make standard clinical-trial designs inadequate. The NC State team hopes to design a statistical model that can handle such complexity.

"...these statistical methods are broadly applicable...to any disease in which the treatment of patients would involve multiple decisions made over time according to the patient's response up to that point."

— Dr. Anastasios "Butch" Tsiatis

"We hope to develop statistical designs where patients can be randomized at different points in time to the next step in the cycle," said Tsiatis, "with the goal of finding the optimal treatment strategy that dictates how best to cycle patients on and off over time according to how they're doing at each stage."

The team believes their statistical work goes beyond HIV clinical research.

"We think these statistical methods are broadly applicable," Tsiatis said. "They're relevant to any disease in which the treatment of patients would involve multiple decisions made over time according to the patient's response up to that point. The research in the MERIT award will extend greatly our current work, and help us deal with much more complex strategies."

PHOTO BY SALLY RAMEY

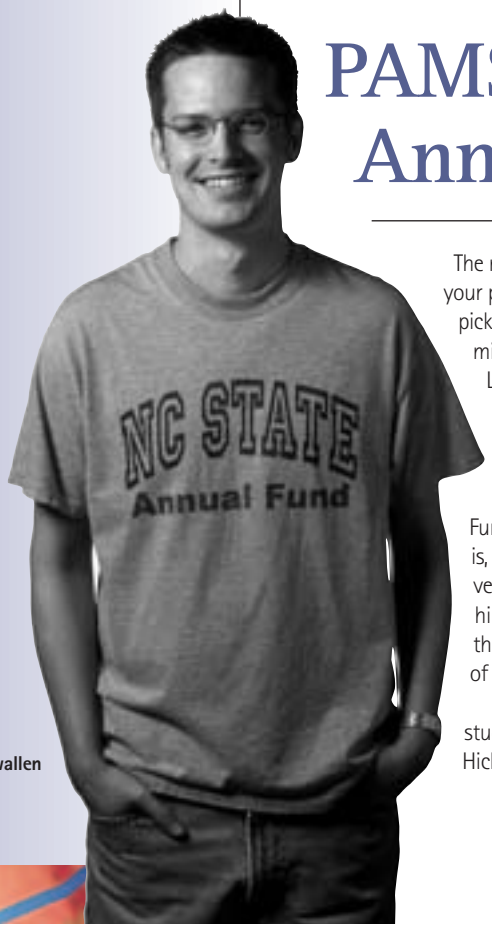
MEAS receives gift from Shell Oil

Earlier this fall, scientists and executives from Shell Oil Company presented PAMS a gift of $25,000.

The group made a whirlwind visit to campus, presenting four checks totaling $100,000 to PAMS and the Colleges of Engineering and Management.

NC State was one of 20 universities receiving donations through the Shell Departmental Grants program to support research and teaching in critical academic fields. PAMS' gift will support graduate programs in the earth sciences offered by the Department of Marine, Earth and Atmospheric Sciences.

Shown are Dean Dan Solomon with Shell representatives Jon Seveney, David Gates, Elizabeth Boehm-Miller and Heather Herndon.



Nate Lewallen

PAMS student trains Annual Fund callers

The next time your phone rings, pick up—it might be Nate Lewallen calling from the NC State Annual Fund. And if it is, your conversation with him will be the high point of your day.

Lewallen, a student from Hickory, is enthusiastic about NC State, and especially about PAMS. And his enthusiasm and hard work have paid off. He'll soon receive a double major in applied mathematics and statistics and he's a member of Pi Mu Epsilon, the math honor society. After graduation he hopes to find a job that calls upon his expertise in statistics.

He started work as an Annual Fund caller three years ago and has become the lead student supervisor. Lewallen is currently training student callers to answer questions about the National Do Not Call Registry. NC State, like other charitable and educational institutions, is exempt from the registry.

Lewallen's work has let him see first-hand what a difference alumni giving can make. Contributions made through the Annual Fund can be directed to PAMS, where they are used primarily to support undergraduate scholarships.

"I look forward to supporting the Annual Fund for PAMS when I graduate because I know how critical those unrestricted dollars are for our college," Lewallen said. And he can't wait to get his first call, he said, so he can, "see how my callers are doing!"

So when the phone rings, pick up! Even if it's not Nate Lewallen, you'll get a lift from talking to a current student, plus the satisfaction of making a gift that makes a difference.

Alumni provide new lobby furnishings

Three alumni have made contributions to refurbish the lobby area between Cox and Dabney.

Originally designed and built by PAMS student council members in the late 1960s through mid-1970s, the furnishings in the lobby had become worn and unsightly. In recent years, the furniture had also been in the way during key events.

"The lobby is the only large open area within the College's central buildings," said Anita Stallings, executive director of the PAMS Foundation. "The College and the Physics and Chemistry departments had an increasing need for receptions and other events in this area, sometimes for more than 100 people. The original furnishings made mingling, serving of food and crowd management almost impossible. And our students needed an area more comfortable and inviting for study."

The dark concrete walls were also not conducive to the lobby's function as the College's main gathering space.

Now, the lobby has a new life, thanks to Nancy Ridenhour (Statistics '76) and Mary Chaney (Mathematics, '78) and Marvin Chaney (Computer Science, '76), who graciously provided funding for new furnishings.

The gray concrete has been covered in paint matching nearby hallways, significantly brightening the area. The furnishings have been replaced by sectional sofas and end tables that can easily accommodate events. And the floor has been covered in new carpet divided into squares that can be replaced if soiled or damaged.

Ridenhour and the Chaneys were among the students who built the original furnishings.

"I think we still feel a sense of ownership and responsibility for this student lobby area," Ridenhour said. "It's always had a special place in our hearts—probably because it was something 'real' we could leave behind for other students to enjoy."

On behalf of its students and faculty, the College of Physical and Mathematical Sciences expressed deep appreciation for this support at a dedication ceremony. The area has been named the Ridenhour–Chaney Lobby, and the gift is honored on a commemorative plaque.

PHOTO BY SALLY RAMEY

Marvin and Mary Chaney and Nancy Ridenhour (seated) were recognized by Dean Dan Solomon and PAMS Student Council President Allison Hill at a dedication ceremony for the newly named Ridenhour–Chaney Lobby, commemorated on the wall plaque shown here.

PHOTO BY ROGER WINSTEAD

The new furnishings make quite a difference in the lobby's overall appearance.

Science House a partner in $21 million math/science project

The Science House has been named a partner in the NC Partnership for the Improvement of Mathematics and Science (NC-PIMS).

The $21.3 million federally funded project, based in the Office of the President of the University of North Carolina (UNC) system, will focus on improving K–12 student achievement in mathematics and science in 17 southeast North Carolina school systems.

The five-year project is a partnership of the school systems, NC State, the UNC Mathematics and Science Education Network and faculty from UNC-Wilmington, UNC-Greensboro, East Carolina University, UNC-Pembroke and Fayetteville State University.

"Our involvement in this important project is another way that Science House collaborates with teaching colleagues across the state to prepare both teachers and students for leadership in mathematics and sciences in the 21st century," said David Haase, professor of physics at NC State and director of the Science House.

Haase serves as co-principal investigator for NC-PIMS and will co-lead the science professional development program with Dr. Jose D'Arruda, professor of physics at UNC-Pembroke.

The project's goals are to enhance the professional development of teachers and to encourage student interest in math and science.

Over the course of the project, more than 1,000 K-12 math and science teachers will participate in training programs aimed at improving student achievement in the classroom.

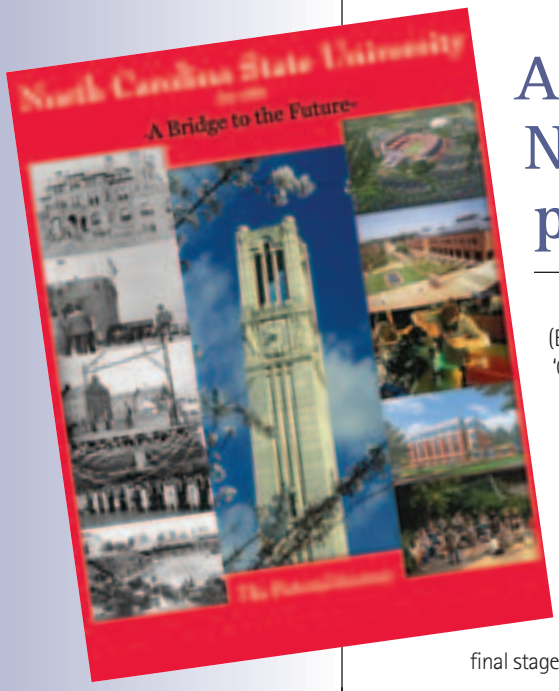
Challenge grant supports Science House

An anonymous donor has announced a challenge grant of $250,000 for The Science House endowment.

"The Science House is a mature program that has established itself as a national model for K-12 science and mathematics outreach," said Anita Stallings, executive director of the PAMS Foundation. "Two alumni have used the challenge grant to provide $80,000 for The Science House. We hope others will step forward to support this worthwhile program."

Not only will the anonymous donor match contributions one-to-one to the general Science House Endowment, but the donor will support endowments in other donors' names. For example, if "Jane Smith" establishes an endowment in her name to support The Science House, the anonymous donor would designate a match into the Jane Smith endowment. This enables Jane Smith to double the value of her gift.

The challenge grant ends Dec. 31, 2004. For information about making a contribution, see "How to Make a Gift" on the opposite page.



Alumnus publishes NC State University pictorial history

Adam Smith (BS Meteorology, '02) is at it again. Featured in the last issue of *Scope* for his book on the western North Carolina town of Hiddenite, Smith has begun the final stages of publishing a treasure trove of photos from throughout NC State's history.

A bit shy about admitting his pursuit of graduate studies at the University of North Carolina, Smith said this project was a labor of love for his alma mater. The 160-page *North Carolina State University—A Bridge to the Future* features 300 photographs, many never before published.

For more information, visit www.absmithbooks.com.

You've got mail!

Alumni have given positive feedback about *PAMS Focus*, the College's periodic e-mail news bulletin.

PAMS Focus is distributed every several weeks to alumni and friends, keeping them up-to-date on the latest news. Items are short and include Web links for those who want additional details.

PAMS Focus doesn't include graphics that can clog up one's e-mail box.

To receive *PAMS Focus*, send an e-mail to pamsalumni@lists.ncsu.edu.

Etch your name into the Walk of Discovery

Many alumni have reserved laser-etched bricks in the "Walk of Discovery." To coincide with the construction of the new Undergraduate Science Teaching Laboratory (USTL) building, the Walk of Discovery will include bricks engraved with the names of alumni, faculty, staff, students and friends. Proceeds from the sale of the bricks will support scholarships within the College.

The original order of bricks has been installed. However, we will continue taking orders and periodically add additional etched bricks to the walk when we have accumulated enough for an order.

If you want to install a brick on the Walk of Discovery, contact the PAMS Development Office at 919-515-3462 and we will fax the order form to you. We can accept orders by fax with credit card information.

Send us your news! We want to hear from alumni, students, faculty and staff members, and other supporters of the College. Awards, accomplishments, career changes—Let us hear from you!

NAME _____ EMPLOYER _____

DEGREE/YEAR AWARDED _____ E-MAIL _____

ADDRESS _____

HOME PHONE _____ WORK PHONE _____

HERE'S MY NEWS (PLEASE PRINT)

_____

_____

Clip and mail to: NC State College of Physical and Mathematical Sciences, Box 8201, Raleigh NC 27695–8201
Or send an e-mail to: pamsalumni@lists.ncsu.edu.

How to make a gift

Many alumni remember how difficult it was to manage the expense of higher education and want to find a way to help today's students achieve their dreams.

The PAMS Foundation provides many ways to support students, faculty and programs of the College. Whether you want to contribute to an existing scholarship, support a departmental enhancement fund, make a memorial gift, or consider more significant support, our staff is available to help you explore the options.

To support existing funds

To contribute to a scholarship, fellowship or other fund, simply mail a check to the NC State Physical & Mathematical Sciences Foundation, Campus Box 8201, Raleigh, NC, 27695. Make checks payable to PAMS Foundation and write the name of the fund on the "notes" or "for" line.

And if your employer provides matches for charitable donations, please send a completed matching gift form with your contribution.

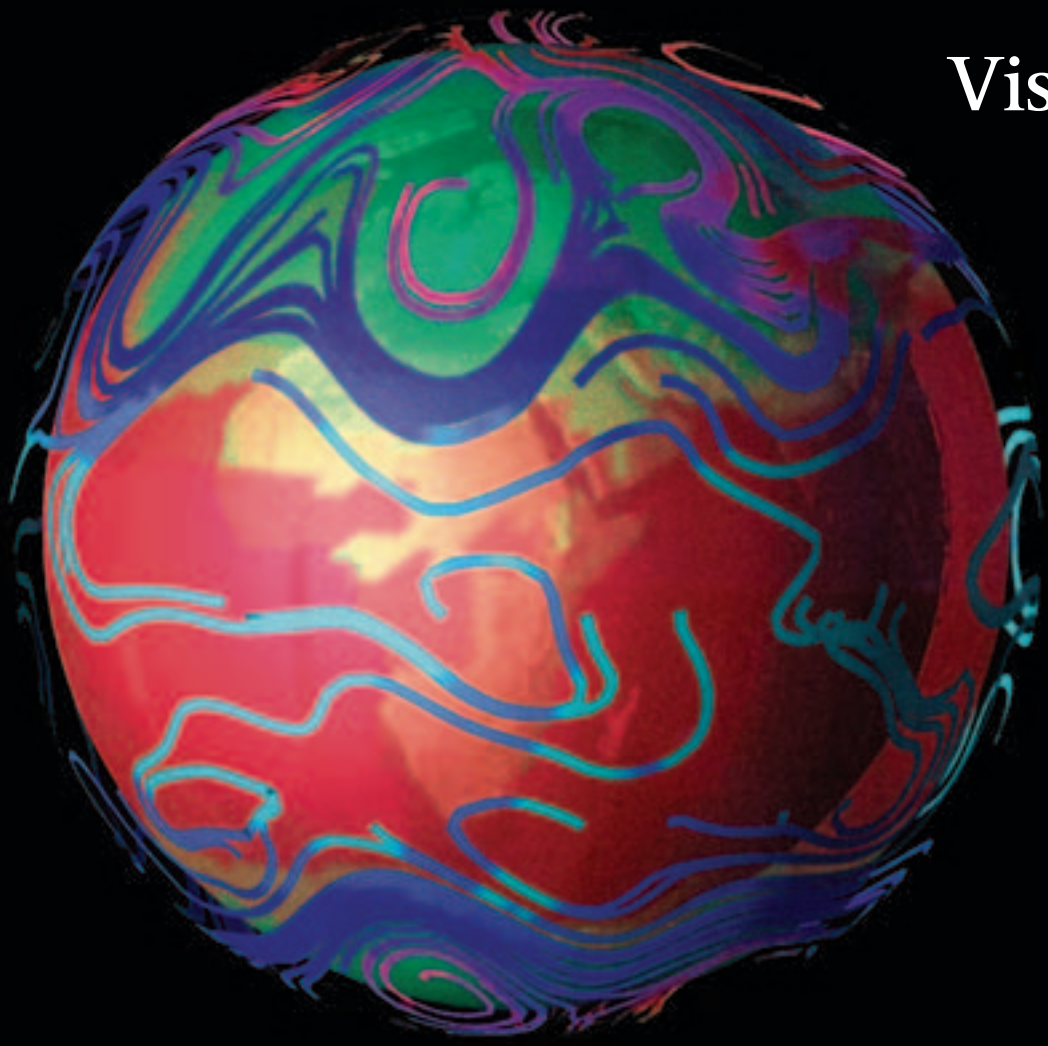
There are many funds not mentioned in this issue of *Scope*, and several have specific designated uses. If you would like information on our various funds to help you decide the best fit for your support, please give us a call at 919-515-3462.

To explore other options

If you have questions about gift planning, we can help you identify tax benefits, choose between permanent endowment vs. one-time support, and explore estate planning or life-income options.

There are many ways to match your interests with specific College needs, and several possibilities for making your vision a reality. Whether using cash, appreciated assets, real estate or a bequest, we can help you find the best way to make the most of your gift.

Contact us today at 919-515-3462 or by e-mail at pamsalumni@lists.ncsu.edu.



Visualizing data

Computer models and computer-generated images are important tools for today's scientist.

Whether explaining scientific information to students in a classroom, to reporters in a newsroom, or to executives in a board room, the ability to communicate is vital.

Using effective visual illustrations of data can help convey complex concepts, such as in the image at left, which was developed by Mathematics Department faculty Jeff Scroggs and Fred Semazzi and then-graduate student George Pouliot. The colors represent temperatures of upper-atmospheric winds and the planet surface.

As technology has improved, the use of such images has increased. Today, scientists can even compete for awards in effective computer model images. PAMS faculty have won several such awards, including one for this image.

NC STATE achieve!

scope

The College of Physical and Mathematical Sciences is made up of internationally recognized departments:

Physics
Mathematics
Chemistry
Molecular & Structural Biochemistry
Statistics
Marine, Earth & Atmospheric Sciences

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